An Energy Efficiency Workshop & Exposition

Palm Springs, California

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An Energy Efficiency Workshop & Exposition

Palm Springs, California

Counting the Benefits of ESPCs: Energy Savings and More

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EPA Energy Use

- The U.S. EPA collects energy and water consumption data from its 20 owned laboratories
- E.O. 13123: 20% reduction by 2005
  - Spirit of Executive Order to reduce emissions
  - Specifies laboratories as part of Federal energy reduction efforts
  - How do we get there?

NVFEL – Ann Arbor, MI

National Vehicle and Fuel Emissions Laboratory (NVFEL)

Background

- 135,000 square foot facility in Ann Arbor, Michigan
- Requires precise environmental control under widely varying load conditions
- One of EPA's most energy intensive sites
  - Using almost 3 MW per year
  - Over $1 million in annual utility costs

NVFEL – Ann Arbor, MI

The Need:

- 30 year old energy infrastructure in dire need of replacement. For example:
  - Test cell AHUs before ESPC conditioned 100% outside air to supply space, and air was then exhausted after the first pass
  - Baseline water consumption 31,373,000 gallons / year

NVFEL – Ann Arbor, MI

The Answer? ESPC

- Reduce source emissions, energy consumption, and energy costs through 11 ECMs
- Exceed federal energy reduction mandates
- Eliminate CFCs
- Reduce water consumption
- Minimize wasted energy
- Provide simple payback on contractor's capital expenditure of less than 10 years
- NORESCO

NVFEL – ECM 1

Test Cell AHUs

- Replace 14 rooftop AHUs supplying the test cells
  - Removal of old units, steam piping, humidifiers, and exhaust fans
- New units installed with:
  - Indirect evaporative coolers, preheat coils, cooling coils with face and bypass dampers and spray atomizing humidifiers
  - New temperature controllers

NVFEL – ECM 1 & 2

NVFEL – ECM 2

Soak Area AHUs

- Four roof-mounted HVAC units installed to serve soak areas
  - Water heated and cooled
  - Total energy recovery wheel installed to precondition air supply
- New temperature controls
  - Maintain space conditions
  - Remote monitoring of units, remote set point adjustment

NVFEL – ECM 3

Office Preparation AHUs

- Removed 11 roof-mounted HVAC systems for offices, controls rooms, labs, and preparation rooms
- New units installed
  - Return air, preheat coils, cooling coils
  - New temperature controllers

NVFEL – ECM 4

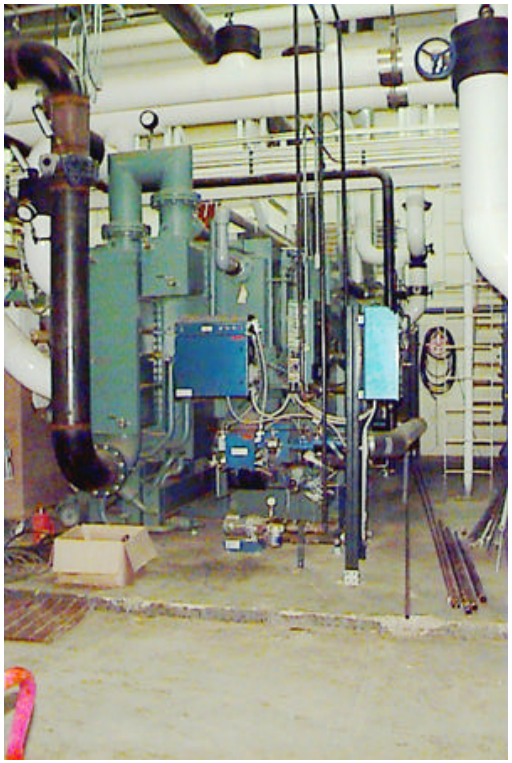
Replace Boilers and Chillers

- Provided NVFEL with entirely new heating and cooling plant
- Water chillers converted from CFC-based mechanical refrigeration to non-CFC, two-stage absorption technology
- High-pressure steam boilers removed, now generated by same absorption units

NVFEL – ECM 4 (cont'd)

- New cooling tower installed on roof
  - Removed existing one from site
- Existing 5,000 gallon fuel oil tank remains intact outside boiler room
  - Serves as back-up for dual fuel absorbers and for the emergency genset

NVFEL – ECM 4 (cont'd)



NVFEL – ECM 5

Install Energy Management System (EMS)

- In the past, control of HVAC equipment was performed manually
  - HVAC systems ran excessively due to various occupancy schedules
- NORESCO proposed and installed state-of-the-art EMS that controls building temperature, tracks energy usage, and controls HVAC equipment based on occupancy

NVFEL – ECM 6

Process Water Conservation

- Use chilled water to cool process loads at the facility

NVFEL – ECM 8

Power Factor Correction

- NVFEL is supplied with power by Detroit Edison under the Primary Supply Rate service classification
  - This rate structure includes a reactive demand charge for each kVA of lagging demand
- NORESCO installed capacitators and controls to increase the facility power factor to at least 90%, the penalty threshold

NVFEL – ECM 10

Natural Gas Fuel Cell

- Installed a 200 kW fuel cell powered by natural gas
  - Provides stable power
  - Converts natural gas into electricity to provide a quiet, clean and efficient on-site generating system
  - Dual cooling loops did not materialize
- Electric generation is working

NVFEL – ECM 10

NVFEL – ECM 11

Cold Test Facility – Conversion to Central Plant Cooling

- Improved efficiency of Cold Test Facility chiller system by serving it with chilled water from the central plant

Results of ESPC

(January 1, 2001- December 31, 2001)

ECM	Electrical Savings (kWh)	Water Savings (Gal)	Fossil Fuel Savings (Mtbu)
ECM –1 Test Cell AHU	2,282,727	6,636,761	50,296,092
ECM-2 Soak Area AHU	409,922	1,118,925	16,532,768
ECM-3 Office and Preparation Area AHU	1,249,443	1,913,020	14,212,372
ECM-4 Replace Boilers and Chillers	757,603	0	(9,719,424)
ECM-5 Install EMS	120,271	0	3,283,019
ECM-6 Process Water Conservation	(5,604)	11,422,149	(406,013)
ECM-8 Power Factor Correction	0	0	0
ECM-10 Natural Gas Fuel Cell	1,187,717	0	(7,966,809)
ECM-11 Cold Test Facility – Conversion to Central Plant Cooling	19,270	0	(71,739)
TOTALS	**6,021,350**	**21,090,854**	**66,160,265**

Measurement & Verification (M&V)

M&V Plan : Documenting Energy Savings

- EMS tracks energy performance of new equipment
  - comprehensive data logging
  - EMS continuously logs variables and calculates energy usage by system
  - NORESCO accesses stored data and sends to M&V group for processing

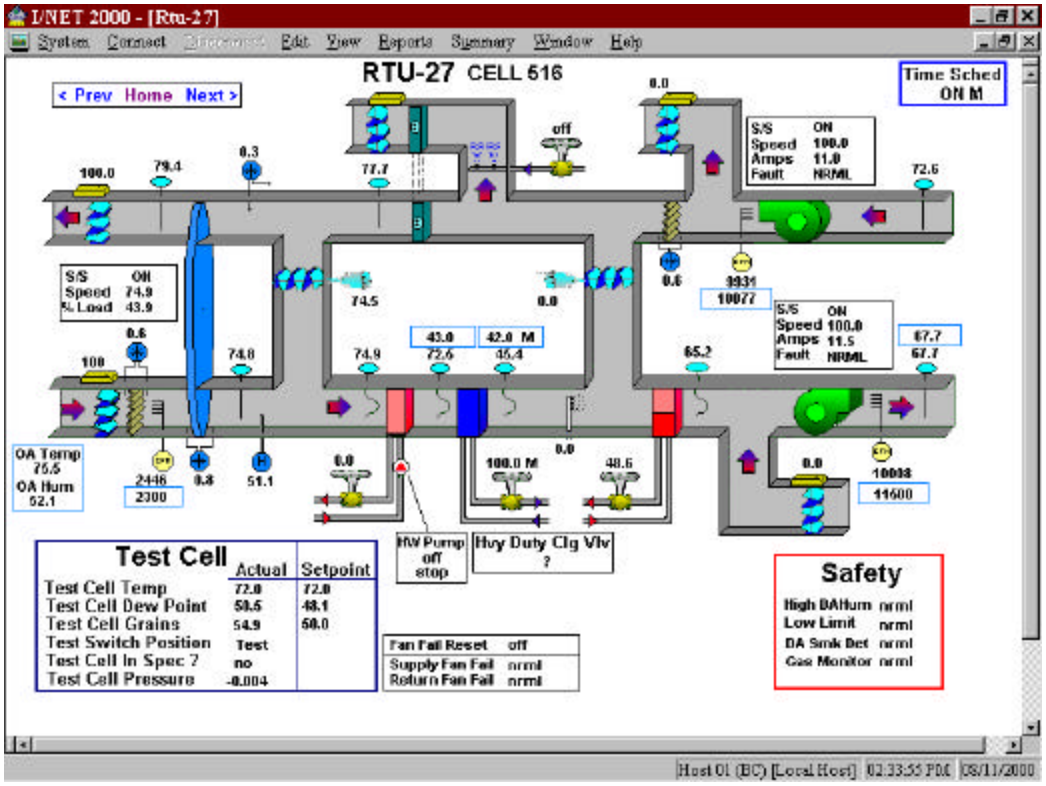
Measurement & Verification (M&V)

Evaluating the M&V Plan

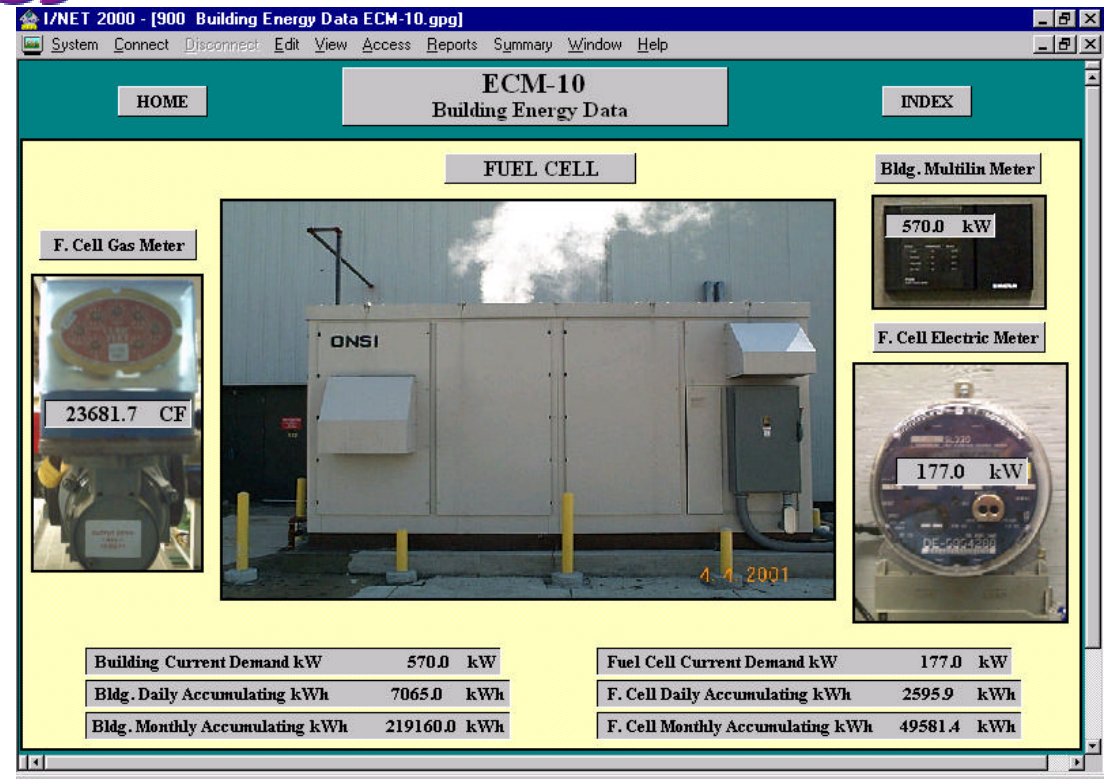
- Third party evaluation of M&V report
  - Architectural Energy Corporation (AEC)
- EMS tracks energy performance and calculates real time energy savings
  - AEC looked at each ECM to determine if EMS calculated energy savings as specified in M&V plan

Control System Main Page

Typical Laboratory Test Cell AHU



Fuel Cell Energy Accounting



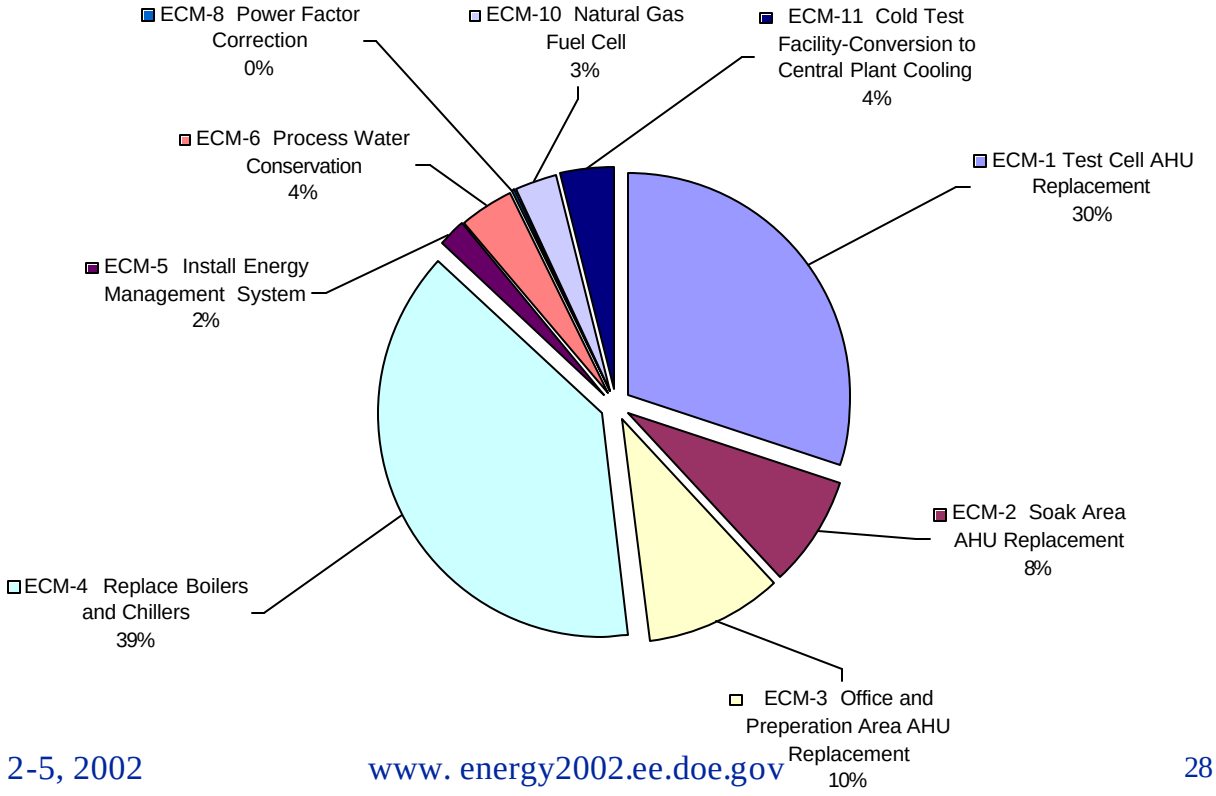
Total $ Savings

(January 1, 2001 – December 31 2001)

ECM	Electrical Savings ($ kWh)	Water Savings ($ Gal)	Fossil Fuel Savings ($ Mtbu)	Total $ Savings
ECM–1	$66,854	$27,184	$213,837	$307,875
ECM-2	$12,005	$4,757	$70,290	$87,052
ECM-3	$35,857	$7,836	$60,425	$104,117
ECM-4	$22,188	$0	($41,323)	($19,135)
ECM-5	$3,522	$0	$13,958	$17,480
ECM-6	($164)	$46,785	($1,726)	$44,895
ECM-8	$0	$0	$0	$0
ECM-10	$34,784	$0	($33,871)	$913
ECM-11	$564	$0	($305)	$259
Sub Total	**$175,610**	**$86,562**	**$281,284**	**$543,456**
Sub Total + Demand Charge of $489, 434 = TOTAL SAVINGS				**$1,032,890**
Annual Guaranteed Savings – Second Year				**$1,093,856**
Less Annual Maintenance Savings – Second Year				**$205,062**
Amount Above Guarantee				**$144,096**

Cost Savings By ECM

(January 1, 2001 – December 31, 2001)



Emissions Reductions

Electrical & Fossil Fuel Savings			Emissions Offsets (Combined)		
ECM	**kWh**	**Mbtu**	**CO_2 (tons)**	**NO_x (tons)**	**SO_2 (tons)**
1	2,282,727	50,296,092	4,805	7.5	10.4
2	409,922	16,532,768	1,287	1.7	1.98
3	1,249,443	14,212,372	1,876.2	3.4	5.5
4	757,603	-9,719,424	100	1.18	3
5	120,271	3,283,019	288.8	.4	.55
6	-5,604	-406,013	-27.7	-.03	-.03
8	0	0	0	0	0
10	1,187,717	-7,966,809	568.1	2.2	4.9
11	19,270	-71,739	12.47	.03	.08
TOTAL	**6,021,349**	**66,160,266**	**8,910**	**16.5**	**26.5**

Trading Value

	Electrical (kWh)	Natural Gas (Mtbu)	CO_2 (tons)	SO_2 (tons)	NO_x (tons)
Savings	6,021,349	66,160,266	8,910	26.5	16.5

- ~~Retire carbon~~
- NO_x: = $7,425 to $29,700 (16.5 tons x 0.9 (MDEQ air quality retirement) x $500 to $2000)*
- Federal SIP NO_x : forward trade for 2003: 16.5 tons x $5,900 = $97,350
- SO_2: $13,250 to $53,000 (26.5 tons x $500 to $2000)*

* values based on Michigan ERC

Intangible Benefits

What Else Do We Gain?

- Ability to make major upgrades
- Meet Executive Order 13123 goals
  - Executive Order does not exempt laboratories
- Model for other laboratory facilities
- Living agency's mission

Ada, Oklahoma

- Replicate Ann Arbor in more traditional lab
- Using DOE's Super ESPC
- Shorter lead time
  - 16 months from project award to completion
  - Versus 30 months for Ann Arbor
- Drilling 175 geothermal wells (completed) and ground source heat pump
- Improving mechanical systems
- Anticipated energy use reduction: 60%

Laboratories for the 21st Century (Labs21)

- A joint EPA/DOE program to improve the environmental performance of U.S. laboratories
- The goal of the program is to encourage the design, construction, and operation of sustainable, high-performance, facilities that will:
  - Minimize overall environmental impacts
  - Protect occupant safety
  - Optimize whole building efficiency on a life-cycle basis

Labs21: Program Components

- Pilot Partnership Program
- Training
- Best Practices
- Labs21 2002 Annual Conference, October 7-9, 2002, Durham, North Carolina
- Labs21 Web site: www.epa.gov/labs21century